

Supplementary Material

The supplementary material is composed of pictures of the sample sites (Figure S1), an equation demonstrating the mass balance of the measured catchment averaged denudation rates (Equation S1), a table summarizing the geographical location, day, and time of samples collection (Table S1), and a table containing the full data on the chemical composition of the each sample according to the ICP-MS analysis conducted by the Activation Laboratories Ltd. based in Ontario, Canada (Table S2).



Figure S1. Pictures of the sample sites. The location of samples PLE08, RHE01 and RHE02 were not photographed.

Equation S1. Mass balance

$$(a * D_1) + (b * D_2) = 1 * D$$

The terms a and b represent the relative proportion of the area of the Plessur Basin, where the upstream part is 50% and the downstream part is also 50%. Accordingly, $a = 0.5$ and $b = 0.5$, thus $a + b = 1$. Denudation rates in the upstream part D_1 equal 0.4 mm a^{-1} , whereas the denudation rates in the downstream part D_2 are unknown. The denudation rate D of the entire basin equals 0.8 mm a^{-1} , accordingly, $D = 0.8 \text{ mm a}^{-1}$. Therefore, D_2 can be calculated as follows:

$$\begin{aligned} \left(0.5 * 0.4 \frac{\text{mm}}{a}\right) + \left(0.5 * D_2 \frac{\text{mm}}{a}\right) &= 1 * 0.8 \frac{\text{mm}}{a} \\ \left(0.2 \frac{\text{mm}}{a}\right) + \left(0.5 * D_2 \frac{\text{mm}}{a}\right) &= 0.8 \frac{\text{mm}}{a} \\ D_2 &= 1.2 \frac{\text{mm}}{a} \end{aligned}$$

The result of this mass balance means that, while the upstream half of the Plessur Basin yields a denudation rate of 0.4 mm a^{-1} , the downstream half requires a denudation rate of 1.2 mm a^{-1} to reach the total measured denudation rate of 0.8 mm a^{-1} . In other words, the downstream portion of the Plessur Basin, comprising the Lower Penninic Units, requires up to three times larger contribution to reach the measured 0.8 mm a^{-1} .

Table S1. Location, day, and time of sample collection.

Sample	Longitude*	Latitude*	Date of Collection	Time of Collection
PLE01	9.546816	46.83529	15.07.2019	11:37
PLE02	9.549314	46.83545	15.07.2019	11:59
PLE03	9.614563	46.81399	15.07.2019	13:54
PLE04	9.658927	46.82722	15.07.2019	15:33
PLE05	9.706768	46.818	15.07.2019	16:43
PLE06	9.709442	46.8186	15.07.2019	17:03
PLE07	9.704013	46.82169	15.07.2019	17:33
PLE08	9.682774	46.77642	15.07.2019	18:30
PLE09	9.685765	46.77529	15.07.2019	18:41
PLE10	9.510231	46.86273	16.07.2019	10:23
RHE01	9.503988	46.8629	16.07.2019	10:40
RHE02	9.498726	47.03002	16.07.2019	11:35

* The coordinates are in the CH1903_LV03 system.

Table S2. Complete results of the ICP-MS analysis showing the composition of each sample.

Analyte Symbol	SiO2	Al2O3	Fe2O3(T)	MnO	MgO	CaO	Na2O	K2O	TiO2	P2O5	LOI	Total
Unit Symbol	%	%	%	%	%	%	%	%	%	%	%	%
Detection Limit	0.01	0.01	0.01	0.001	0.01	0.01	0.01	0.01	0.001	0.01		0.01
Analysis Method	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	GRAV	FUS-ICP
PLE01	45.96	7.77	3.15	0.061	2.03	20.61	0.65	1.36	0.394	0.16	18.3	100.4
PLE02	38.16	6.66	3.45	0.068	5.04	21.42	0.55	1.15	0.404	0.13	21.44	98.47
PLE03	34	7.56	3.23	0.083	7.18	19.68	0.48	1.53	0.406	0.1	24.54	98.79
PLE04	34.93	7.72	3.82	0.068	7.87	20.24	0.56	1.32	0.494	0.12	23	100.1
PLE05	23.62	5.13	3.11	0.085	14.87	20.79	0.33	1.06	0.325	0.07	29.41	98.8
PLE06	34.64	4.26	2.87	0.068	7.42	23.08	0.55	0.69	0.445	0.13	24.42	98.57
PLE07	29.91	5.54	3.16	0.073	9.93	21.92	0.5	1.03	0.426	0.1	25.85	98.42
PLE08	42.64	11.05	6.39	0.157	10.04	7.89	0.78	1.99	0.662	0.14	17.18	98.94
PLE09	4.41	1.18	0.69	0.057	19.49	29.29	0.05	0.35	0.06	0.02	43.88	99.48
PLE10	35.1	5.61	3.33	0.066	5.17	24.46	0.49	0.92	0.471	0.17	23.88	99.67
RHE01	44.15	4.25	2.47	0.078	2.47	24.41	0.62	0.66	0.281	0.19	20.59	100.2
RHE02	42.79	4.24	2.54	0.079	2.36	25.74	0.61	0.63	0.305	0.19	21.15	100.6

The ICP-MS analysis and measurement were carried out by the Activation Laboratories Ltd. in Ontario, Canada.

Table S2. Continuation.

Analyte Symbol	Sc	Be	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Rb
Unit Symbol	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit	1	1	5	20	1	20	10	30	1	0.5	5	1
Analysis Method	FUS-ICP	FUS-ICP	FUS-ICP	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS
PLE01	7	2	62	70	8	50	30	70	10	1	<5	62
PLE02	7	2	60	160	11	90	30	60	9	1	5	56
PLE03	7	2	66	80	10	60	40	110	10	0.7	7	70
PLE04	8	2	72	180	13	110	30	70	10	0.8	9	61
PLE05	6	1	51	280	17	200	30	50	6	0.8	9	44
PLE06	6	1	41	160	11	100	20	40	5	1	11	29
PLE07	7	1	54	200	14	150	30	50	7	0.7	16	45
PLE08	13	2	105	550	42	450	70	130	15	1.3	17	94
PLE09	1	<1	14	<20	<1	<20	<10	40	1	<0.5	<5	15
PLE10	7	1	52	150	11	80	30	60	7	1.1	9	44
RHE01	5	1	31	30	5	20	20	40	5	0.9	12	29
RHE02	5	1	32	30	5	20	20	40	6	0.9	15	27

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Table S2. Continuation.

Analyte Symbol	Sr	Y	Zr	Nb	Mo	Ag	In	Sn	Sb	Cs	Ba	La
Unit Symbol	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit	2	0.5	1	0.2	2	0.5	0.1	1	0.2	0.1	2	0.05
Analysis Method	FUS-ICP	FUS-MS	FUS-ICP	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-ICP	FUS-MS
PLE01	647	19.5	247	7.4	< 2	< 0.5	< 0.1	7	0.4	3.8	197	33.7
PLE02	614	18.4	227	8.1	< 2	0.5	< 0.1	3	0.5	3.4	182	18.1
PLE03	316	14.7	134	8.4	2	< 0.5	< 0.1	11	0.8	4.1	224	17.9
PLE04	457	15.6	218	9.3	< 2	< 0.5	< 0.1	3	0.5	3.4	229	18.8
PLE05	152	11.6	129	6.2	2	< 0.5	< 0.1	4	1.4	3.2	144	13.5
PLE06	531	17.1	361	8	< 2	0.8	< 0.1	3	0.3	1.4	124	15.3
PLE07	387	15	292	8.4	2	0.8	< 0.1	2	0.5	2.7	158	16.8
PLE08	127	21.7	179	11.3	< 2	0.5	< 0.1	7	1.3	6.9	310	26.3
PLE09	112	3.1	51	1.2	< 2	< 0.5	< 0.1	2	0.9	2.5	75	3.15
PLE10	712	28	1039	9.1	< 2	2.2	< 0.1	2	0.5	2.6	153	26.4
RHE01	547	27.4	455	5.4	< 2	0.9	< 0.1	1	0.7	1.9	139	38.5
RHE02	617	29.4	822	5.6	< 2	1.8	< 0.1	3	0.7	1.7	165	46.7

The ICP-MS analysis and measurement were carried out by the Activation Laboratories Ltd. in Ontario, Canada.

Table S2. Continuation.

Analyte Symbol	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
Unit Symbol	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit	0.05	0.01	0.05	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.005	0.01
Analysis Method	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS
PLE01	65.7	7.21	26.2	4.81	0.728	3.82	0.56	3.2	0.63	1.84	0.294	1.93
PLE02	35.8	4.23	15.9	3.82	0.634	3.29	0.52	3.02	0.57	1.66	0.232	1.54
PLE03	35.6	4.1	14.7	3.16	0.565	2.74	0.45	2.55	0.51	1.49	0.22	1.45
PLE04	37.5	4.26	15.9	3.2	0.657	2.97	0.45	2.65	0.53	1.48	0.213	1.47
PLE05	26.8	3.06	11	2.56	0.445	1.96	0.34	1.87	0.36	1.09	0.159	1.14
PLE06	30.9	3.78	15	3.17	0.639	3.3	0.52	2.93	0.6	1.67	0.244	1.74
PLE07	33.5	3.77	15.4	3.14	0.53	2.8	0.47	2.6	0.48	1.41	0.219	1.63
PLE08	52.7	5.8	23.3	4.45	0.928	4.07	0.63	3.67	0.72	2.17	0.32	2.05
PLE09	6.36	0.7	2.5	0.59	0.112	0.54	0.09	0.58	0.11	0.35	0.058	0.39
PLE10	52.1	6.02	23.5	5.14	0.823	4.18	0.74	4.44	0.89	2.74	0.48	3.31
RHE01	77.8	8.66	32.9	6.27	1.02	5.18	0.76	4.44	0.85	2.57	0.366	2.46
RHE02	93.9	10.3	38.8	7.67	1.15	6.33	0.88	5.15	0.94	2.74	0.478	3.06

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Table S2. Continuation.

Analyte Symbol	Lu	Hf	Ta	W	Ti	Pb	Bi	Th	U
Unit Symbol	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit	0.002	0.1	0.01	0.5	0.05	5	0.1	0.05	0.01
Analysis Method	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS	FUS-MS
PLE01	0.299	6.5	0.62	1.4	0.22	13	< 0.1	7.8	2.33
PLE02	0.263	6.3	0.58	1.6	0.2	11	< 0.1	6.27	2.53
PLE03	0.219	3.8	0.67	2.3	0.44	16	< 0.1	5.94	2.77
PLE04	0.237	5.9	0.7	1.4	0.34	12	< 0.1	6.27	2.83
PLE05	0.186	3.6	0.43	1.4	0.34	11	< 0.1	3.78	3.01
PLE06	0.296	10	0.66	1.2	0.16	8	< 0.1	4.7	2.89
PLE07	0.266	8.1	0.61	1.4	0.24	10	< 0.1	5.36	3.25
PLE08	0.319	5.2	0.83	1.9	0.65	34	< 0.1	7.28	2.89
PLE09	0.059	1.6	0.12	< 0.5	0.39	8	< 0.1	1.3	2.31
PLE10	0.579	29.4	0.68	1.5	0.31	15	< 0.1	9.09	5.49
RHE01	0.423	12.7	0.45	1.7	0.07	14	< 0.1	8.99	3.01
RHE02	0.523	23.3	0.52	1.2	0.08	11	< 0.1	9.58	3.99

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